Electronic Services - Los Angeles
M12169X

Instruction Manual
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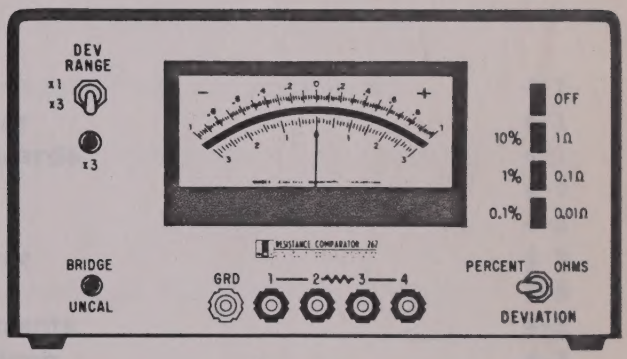
MODEL 262

Resistance Comparator



MP MASTER
MA30734

SERIAL NUMBER:_____
PART NUMBER: 22843

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TABLE OF CONTENTS

1. DESCRIPTION
   - 1.1 INTRODUCTION 1-1
   - 1.2 SPECIFICATIONS 1-1

2. OPERATION
   - 2.1 FRONT PANEL CONTROLS, INDICATORS, AND TERMINALS 2-1
   - 2.2 REAR PANEL CONTROLS AND TERMINALS 2-2
   - 2.3 RECOMMENDED ACCESSORIES 2-2
   - 2.4 BASIC OPERATING PROCEDURE 2-3

3. THEORY OF OPERATION
   - 3.1 BRIDGE CIRCUIT 3-1
   - 3.2 GUARDING 3-1
   - 3.3 SIMPLIFIED CIRCUIT 3-2
   - 3.4 DEVIATION BRIDGE A1 3-3
   - 3.5 ±15 V POWER SUPPLY A2 3-3

4. MAINTENANCE
   - 4.1 PERIODIC MAINTENANCE 4-1
     - 4.1.1 Removing Dust Cover 4-1
     - 4.1.2 Removing Circuit Boards 4-1
     - 4.1.3 Visual Inspection 4-2
     - 4.1.4 Cleaning 4-2
     - 4.1.5 Replacing Dust Cover 4-2
   - 4.2 ALIGNMENT PROCEDURE 4-3
     - 4.2.1 Equipment Requirements 4-3
     - 4.2.2 Preliminary Operations 4-3
     - 4.2.3 Power Supply Alignment 4-3
     - 4.2.4 Standard Generator Alignment 4-3
     - 4.2.5 Unknown Generator Check 4-4
     - 4.2.6 Functional Test and Final Alignment 4-5

5. PARTS LIST AND SCHEMATIC DIAGRAMS
   - 5.1 MAINFRAME 5-2
   - 5.2 DEVIATION BRIDGE CIRCUIT BOARD ASSEMBLY A1 5-4
   - 5.3 ±15 V POWER SUPPLY CIRCUIT BOARD ASSEMBLY A2 5-6

CAUTION!

When making two terminal measurements, terminals 1 and 2 must be connected together and terminals 3 and 4 must also be connected together. The unknown must be connected across terminals 2 and 3.

Failure to make the above connections will result in incorrect readings from your instrument.

Part No. 23141

TABLE OF CONTENTS

1. DESCRIPTION
   - 1.1 INTRODUCTION 1-1
   - 1.2 SPECIFICATIONS 1-1

2. OPERATION
   - 2.1 FRONT PANEL CONTROLS, INDICATORS, AND TERMINALS 2-1
   - 2.2 REAR PANEL CONTROLS AND TERMINALS 2-2
   - 2.3 RECOMMENDED ACCESSORIES 2-2
   - 2.4 BASIC OPERATING PROCEDURE 2-3

3. THEORY OF OPERATION
   - 3.1 BRIDGE CIRCUIT 3-1
   - 3.2 GUARDING 3-1
   - 3.3 SIMPLIFIED CIRCUIT 3-2
   - 3.4 DEVIATION BRIDGE A1 3-3
   - 3.5 ±15 V POWER SUPPLY A2 3-3

4. MAINTENANCE
   - 4.1 PERIODIC MAINTENANCE 4-1
     - 4.1.1 Removing Dust Cover 4-1
     - 4.1.2 Removing Circuit Boards 4-1
     - 4.1.3 Visual Inspection 4-2
     - 4.1.4 Cleaning 4-2
     - 4.1.5 Replacing Dust Cover 4-2
   - 4.2 ALIGNMENT PROCEDURE 4-3
     - 4.2.1 Equipment Requirements 4-3
     - 4.2.2 Preliminary Operations 4-3
     - 4.2.3 Power Supply Alignment 4-3
     - 4.2.4 Standard Generator Alignment 4-3
     - 4.2.5 Unknown Generator Check 4-4
     - 4.2.6 Functional Test and Final Alignment 4-5

5. PARTS LIST AND SCHEMATIC DIAGRAMS
   - 5.1 MAINFRAME 5-2
   - 5.2 DEVIATION BRIDGE CIRCUIT BOARD ASSEMBLY A1 5-4
   - 5.3 ±15 V POWER SUPPLY CIRCUIT BOARD ASSEMBLY A2 5-6

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SECTION 1
DESCRIPTION

1.1 INTRODUCTION

ESI Model 262 Resistance Comparator is a high-speed, high-precision resistance bridge for production testing, trimming, and sorting of discrete resistors. The instrument has six deviation ranges, a calibrated full-scale deviation readout, high ac noise rejection, and guarded four-terminal connections. Measurable resistance range is 1 milliohm through 100 megohms. Speed of response is measured in milliseconds (see specifications).

1.2 SPECIFICATIONS

Bridge Ratio: 1:1

Deviation Ranges:

For Resistance Values > 10 Ω			For Resistance Values < 10 Ω		
±10% ±30%	±1% ±3%	±0.1% ±0.3%	±1 Ω ±3 Ω	±0.1 Ω ±0.3 Ω	±0.01 Ω ±0.03 Ω

Accuracy at Balance: ±(0.01% + 1 milliohm) plus contribution from standard resistor

Detector Analog Output Voltage: Proportional to meter full scale (times 1); ±1 V at full scale with a 10 times overrange capability on the two lower ranges

Deviation Accuracy

Output Voltage: ±(0.5% + 2 millivolts)
Meter Display: ±3% of full scale

Resolution: 0.002% or 0.2 milliohm

Test Voltage-Current

Percent Deviation: 1 V and 5 V selectable by panel switch
Ohms Deviation: 100 mA maximum
Maximum Power: 0.1 W (1 V test)

Bridge Output Response Times (0 to ± full scale):

Unknown	Deviation Range	Typical Response Time	
		1 V, 100 mA	5 V
0 to 10 Ω	1 Ω	2 ms	*
	0.1 Ω	20 ms	*
	0.01 MΩ	200 ms	*
10 Ω to 100 kΩ	10%	2 ms	0.5 ms
(100 Ω to 100 kΩ; 5 V)	1%	20 ms	4 ms
	0.1%	200 ms	40 ms
1 MΩ	10%	40 ms	40 ms
	1%	40 ms	40 ms
	0.1%	200 ms	50 ms
>1 MΩ	All	*	40 ms/MΩ

*Not normally used

Dimensions: Height 14 cm (5.5 in), Width 25.4 cm (10 in) Depth 17.15 cm (6.75 in)

Weight: 4.8 kg (10.5 lb)

SECTION 2

OPERATION

2.1 FRONT PANEL CONTROLS, INDICATORS, AND TERMINALS

OFF pushbutton in upper right-hand corner turns off line power.

Three DEVIATION range pushbuttons beneath determine desired range. Pushing desired button turns unit on.

DEVIATION toggle switch permits selection of deviation reading in PERCENT or OHMS.

DEV RANGE toggle switch selects x1 or x3 meter range multiplier. x3 lamp lights to indicate that DEV RANGE switch is in x3 position.

BRIDGE UNCAL light indicates faulty connection to unknown or wrong setting of DEVIATION switch or R_x V SELECT switch (on rear panel).

Unknown terminals 1, 2, 3, 4 and GRD are for connection of resistor to be measured.

Meter indicates deviation of unknown from external standard times setting of DEV RANGE switch.

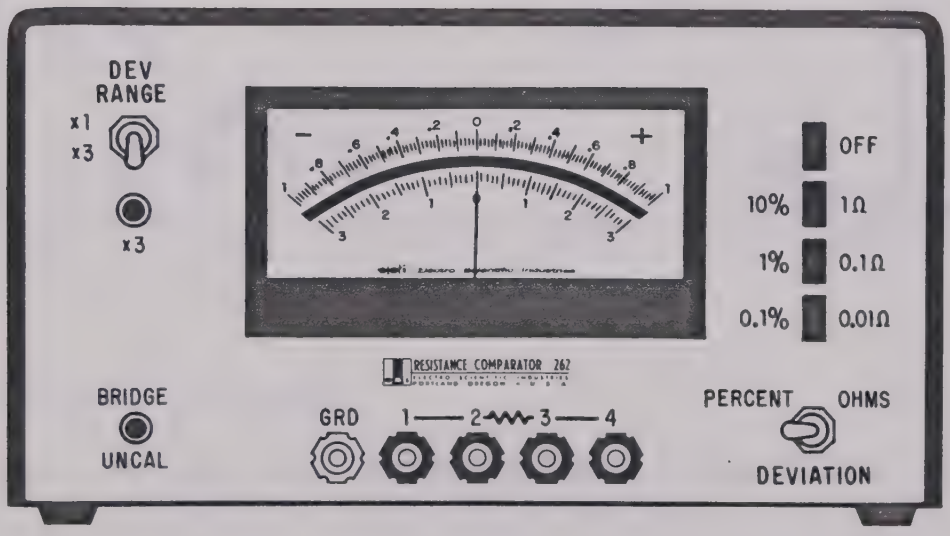
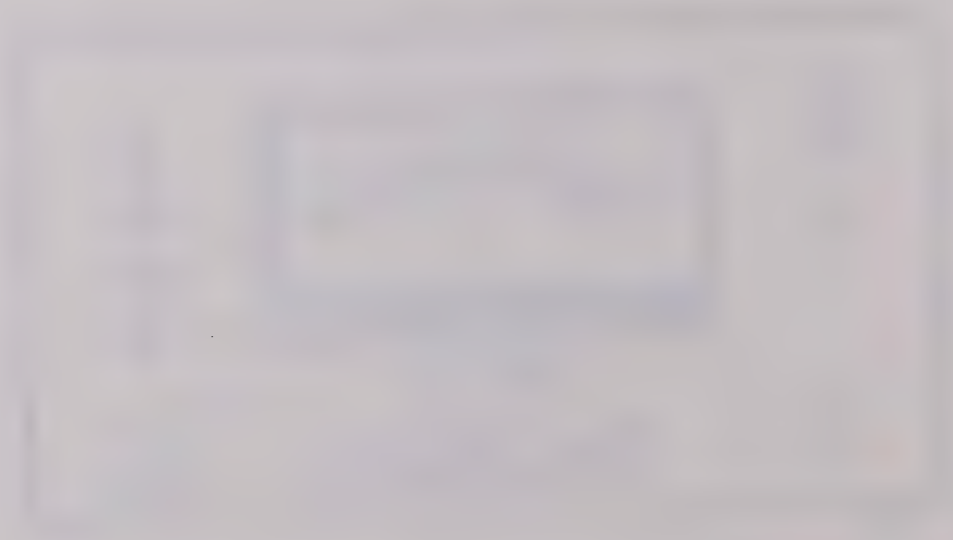


Figure 2-1. Model 262 Front Panel



2.2 REAR PANEL CONTROLS AND TERMINALS

PUSH TO ZERO pushbutton is a momentary-contact switch which must be held while meter zero is being performed.

ZERO knob is used to zero deviation meter. Unknown and standard must be connected for this operation.

R_X V SELECT toggle switch permits selection of optimum test voltage.

1/2 A, 100/125 V FUSE protects the instrument from excessive power damage.

STANDARD terminals GRD, 1, 2, 3, and 4 are for connection of the external standard.

GRD and OUTPUT terminals are for connection to the 10-volt range of a digital voltmeter for auxiliary digital readout.

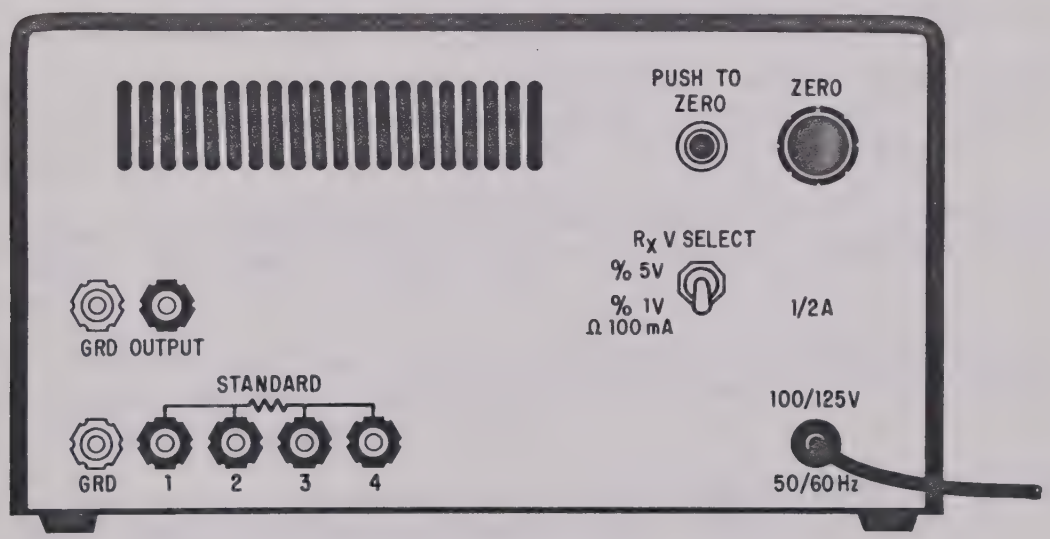
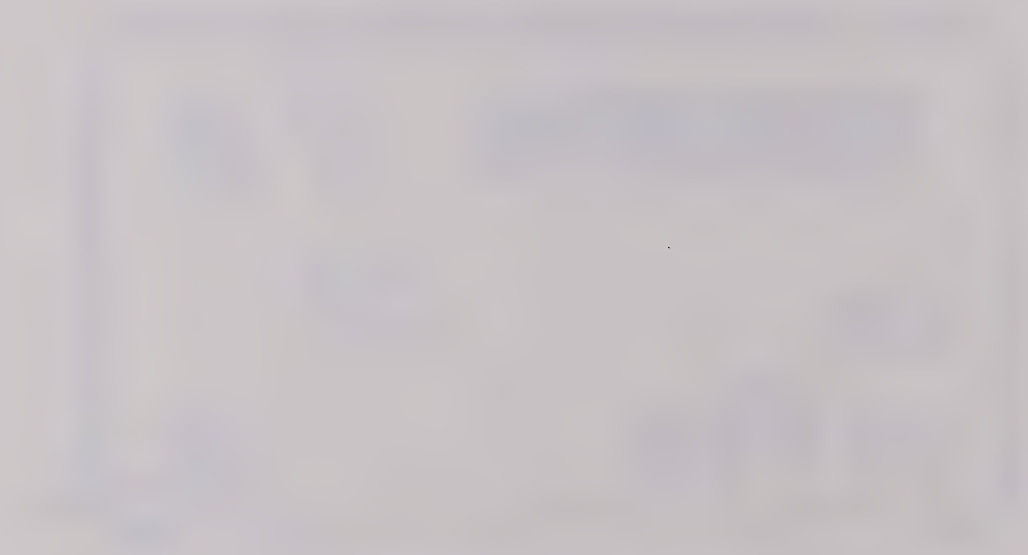


Figure 2-2. Model 262 Rear Panel

2.3 RECOMMENDED ACCESSORIES

Decade Resistor: ESI Model DB 877 DEKABOX® Decade Resistor, 0 to 12 megohms in 0.1 ohm steps; ±0.01% initial accuracy.

Interconnecting Cable: ESI Part Number 18652, shielded, double pair with spade lugs; approximately 30 inches long.



2.4 BASIC OPERATING PROCEDURE

1. Connect standard to STANDARD terminals on rear panel. Use shielded leads for terminals 1 and 2 for standard resistances above 1 kΩ.

2. Connect unknown to terminals on front panel. Use shielded leads for terminals 1 and 2 for unknowns above 1 kΩ.

3. Set DEVIATION switch. Use PERCENT for standard of 10 Ω and above, OHMS for standard below 10 Ω.

4. Set R_X V SELECT switch. 5 V setting is best for resistances above 100 Ω for best signal-to-noise ratio. Use 1 V setting for values below 100 Ω or when minimum power in unknown is required on higher values. Full scale deviation remains the same for both voltages.

5. Press desired range pushbutton. This also turns the unit on.

6. Select desired DEV RANGE multiplier. x3 lamp lights when x3 setting is in use.

7. Check that BRIDGE UNCAL indicator is not lighted. Lamp lights when generator cannot control voltage or current to unknown. If it is on, check unknown connections, DEVIATION switch setting and R_X V SELECT switch setting.

8. (Optional) Connect auxiliary OUTPUT, GRD terminals to 10 V range of digital voltmeter. Scale factor is 1 V/10%, 1 V/1% or 1 V/0.1%, depending on deviation range in use.

9. Press PUSH TO ZERO button on rear panel and zero the meter with ZERO knob, if necessary. Unknown and standard must be connected and meter deviation reading on scale for this test.

10. Read panel meter or digital voltmeter. Actual resistance deviation is panel meter reading x DEV RANGE setting x range setting. DEV RANGE setting has no effect on rear panel OUTPUT terminals.

SECTION 3

THEORY OF OPERATION

ESI Model 262 Resistance Comparator makes continuous precision comparisons between two resistors. The resulting difference is displayed as the deviation of the unknown from the standard, in percent or ohms. An analog voltage proportional to this difference is made available for use in process control and tolerance checking.

3.1 BRIDGE CIRCUIT

A four-terminal, active-arm comparison bridge circuit minimizes errors from lead and contact resistances. This is accomplished by making two connections to each end of the unknown and standard resistors. Lead and connection resistances are placed either in generator leads where they will have no effect, in series with the high-value internal bridge arms where they will have an insignificant effect, or in series with the bridge yoke shunt where their effect can be eliminated by the proper yoke ratio.

3.2 GUARDING

The bridge is guarded so that high-resistance leakage paths for both the unknown and standard resistors are intercepted. The chassis is used as the guard shield. Leakage resistances are shunted across low-resistance internal bridge arms or the detector. Guarding of a three-terminal unknown resistor can be accomplished by connecting the bridge chassis to its leakage intercept terminal. This guarding permits accurate measurement of high-value resistors even in humid environment.

3.3 SIMPLIFIED CIRCUIT

Figure 3-1 shows the simplified bridge diagram.

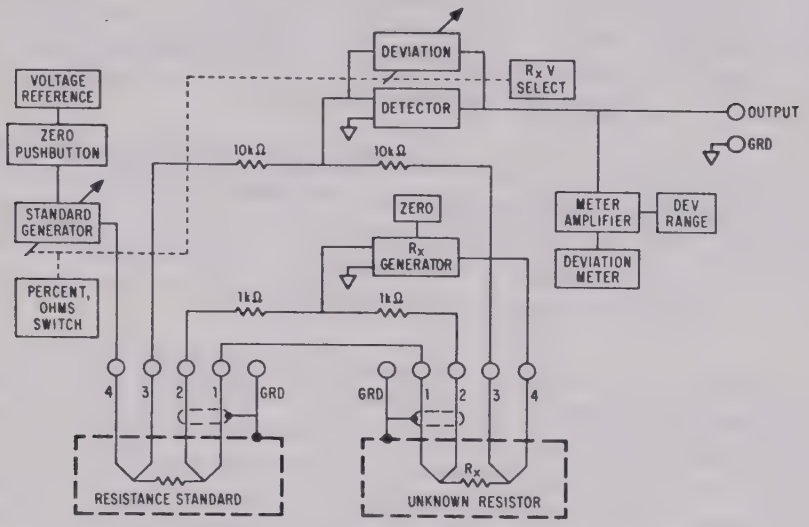


Figure 3-1. Simplified Bridge Diagram Model 262

The standard generator maintains constant voltage (percent deviation) or constant current (ohms deviation) in the standard resistor. A separate R_x generator is connected so that all current passing through the standard resistor also passes through the unknown resistor. The voltage difference is measured by the detector circuits. The deviation pushbutton switches set detector sensitivity. The deviation meter is driven by its own amplifier, which has two range settings, x1 and x3. The R_x V SELECT switch on the rear panel sets the voltage across the standard and adjusts the detector sensitivity to provide a bridge output of ±1 volt at deviation full scale. If the standard generator should lose control (constant voltage or current) for any reason, the BRIDGE UNCAL lamp will light.

The ±15 volt power supply assembly A2 (Part No. 22847) supplies regulated voltage to the bridge, provides a reference voltage for the comparator and supplies the comparator's power.

The deviation bridge assembly A1 (Part No. 22849) places a constant voltage across the resistance standard. This produces a current in the standard. The bridge then drives the same current through the unknown resistor and measures the resulting voltage drop. The voltage difference between the standard and unknown resistors is proportional to the difference in value of the two resistors. This deviation is displayed on the panel meter and made available at the rear panel OUTPUT terminal.

3.4 DEVIATION BRIDGE A1 (ESI Part No. 22849)

The deviation bridge assembly is an active arm bridge, containing both the standard and unknown generators and the detector and meter driver circuits.

The standard generator is composed of U1, Q2 and their associated components. Minus 1 mA is applied to pin 2 of this assembly for programing the generator to produce 1 volt with R2 as the feedback resistor. Q2 is a power booster for U1 and is within the feedback loop of U1. If too large a current demand is placed upon Q2, so that U1 cannot maintain proper control, Zener diode CR2 will turn Q1 on (by way of CR3). This lights the UNCAL light on the front panel.

The unknown generator is composed of U2, Q3 and their associated components. Resistors R10 and R13 are the bridge yoke resistors. At their junction R11 connects to U2 so that it will drive equal current through the unknown and standard resistors. Q3 is a power booster for U2. CR4 and CR5 protect the input of U2 from overloads. R12 and R14 are part of the zero offset compensation of U2.

The detector is composed of U3, U4 and their associated components. R20 and R21 are the bridge ratio resistors. If the bridge is in perfect balance, the junction of R20 and R21 will have zero current to ground. Any deviation in the value of the unknown resistor will cause a current difference at this point which is proportional to that deviation. That difference is then converted to a voltage by U3. The gain of U3 is selected by the front panel DEVIATION RANGE switch. The output of U3, pin P, is connected to the OUTPUT binding post on the rear panel.

This voltage is also used to drive U4, which is the meter amplifier. Q4 and Q5 are meter protection diodes in this circuit. The meter output is pin R. R34 sets the gain of U4 so that the proper meter deflection is obtained for any given deviation.

3.5 ±15 VOLT POWER SUPPLY A2 (ESI Part No. 22847)

This assembly has two identical 15 volt regulators. Because the two circuits are identical, only one will be detailed here.

The transformer winding connects to the circuit at pins R and S (pins A and B for the other circuit). The unregulated ac voltage from the transformer is rectified by the full wave bridge formed by CR1 through CR4. Capacitor C1 filters the rectified ac voltage.

Integrated circuit voltage regulator U1 has a voltage reference, an error amplifier, a series pass transistor and a provision for current limiting. An additional series pass transistor Q1 is used because the transistor within U1 does not have sufficient current capability.

Resistors R3, R4, and R5 set the output voltage. R4 is trimmable and is used as a fine voltage trimmer.

Capacitor C3 stabilizes the error amplifier in U1. If C3 were faulty, it could cause errors in the output voltage or circuit oscillation.

R1 sets the current limiting level of the output. When the voltage drop across R1 reaches approximately 0.65 volt, the output will current limit.

Capacitor C5 is the final output filter. An open capacitor could cause excessive ripple, while a shorted capacitor could result in less available current or a drop in the output voltage.

SECTION 4

MAINTENANCE

4.1 PERIODIC MAINTENANCE

The following procedures should be performed approximately once a year to insure maximum accuracy and reliability from the Model 262 Resistance Comparator.

If problems can be isolated to individual parts, the defective parts should be returned to the factory for repair or replacement. If the need for major repairs is apparent, it is recommended that the unit be sent to the factory for service. The service department will be happy to furnish the necessary information for repairs and replacement parts. Unauthorized repairs, however, will invalidate the instrument warranty.

4.1.1 Removing Dust Cover

Remove the four screws, one at each of the top corners of the front and rear panels, and lift the dust cover *straight* up.

4.1.2 Removing Circuit Boards

Grip circuit boards firmly and lift *straight* out of plugs. Locations and placement of circuit boards is shown in Figure 4-1.

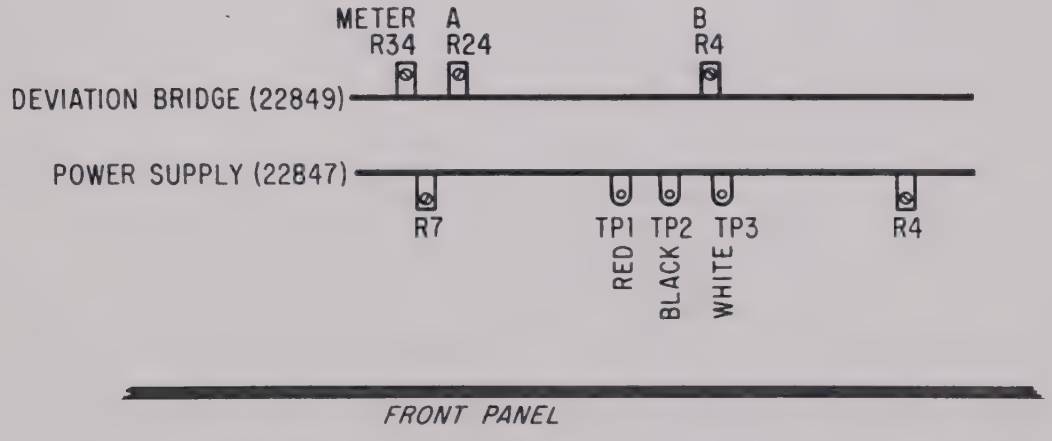


Figure 4-1. Model 262 Test Points and Adjustment Locations

4.1.3 Visual Inspection

Inspect the outside of the unit for damage to binding posts, binding post caps, and panel lamps. Check for dirt around binding post insulators. Inspect the interior for loose or broken connections and damaged or dirty socket contacts.

4.1.4 Cleaning

Clean the front panel with a soft, dry, lint-free cloth, being particularly careful to remove all dirt from around binding post insulators.

4.1.5 Replacing Dust Cover

Be sure the interior of the cover is completely clear of all foreign material. Slip cover *straight* down over unit and replace the screws.

4.2 ALIGNMENT PROCEDURE

4.2.1 Equipment Requirements

Minimum use specifications will aid in the selection of alternate equipment if the recommended equipment is not available. Be sure alternate items meet the requirements.

Item	Minimum Use Specifications
Digital Voltmeter	Accuracy: 0.05% Readout: 4 1/2 digits
Resistance Standards (two required)	Type: Four-terminal Range: 1 Ω to 11 kΩ in 1 Ω steps Accuracy: 50 ppm Recommended Type: ESI Model RS 925

4.2.2 Preliminary Operations

1. With Model 262 off, adjust meter zero if necessary with screw on front panel.

2. Remove dust cover as described in paragraph 4.1.1.

4.2.3 Power Supply Alignment

1. Connect DVM to power supply assembly A2 (Part No. 22847), low side to black test point and high to red test point. See Figure 4-1 for locations. DVM should read +15 V ±0.01 V. If reading is out of tolerance, adjust trimmer R4.

2. Connect DVM high side to white test point and low to black test point. DVM should read -15 V ±0.01 V. If reading is out of tolerance, adjust trimmer R7.

3. Set the DEV RANGE switch to x3. The x3 lamp should light.

4.2.4 Standard Generator Alignment

1. Set one of the resistance standards to 100 Ω and connect it to the Model 262 as follows:

   Standard terminals 1 and 2 —— to Model 262 GRD terminal
   Standard terminals 3 and 4 —— to corresponding Model 262 STANDARD terminals

2. Set the Model 262 controls as follows:

   DEVIATION to PERCENT
   Range to 1%
   DEV RANGE to x1
   R_X V SELECT to 1 V

3. Connect the DVM across the resistance standard, with its low lead to the GRD terminal and its high lead to terminals 3 and 4.

4. Hold down the PUSH TO ZERO button on the rear panel and adjust trimmer B (R4) on the Deviation Bridge Circuit Board (see Figure 4-1) for a DVM reading of zero ±0.2 mV. The Model 262 meter should read in minus polarity.

5. Set the R_X V SELECT switch to 5 V. The DVM should read 5.000 V ±0.02 V.

6. Decrease the setting of the standard until the BRIDGE UNCAL lamp lights. The setting should be between 70 Ω and 85 Ω.

7. Set the R_X V SELECT switch to 1 V. The DVM should read 1.000 V ±0.005 V.

8. Again decrease the setting of the standard until the BRIDGE UNCAL lamp lights. The setting should be between 7Ω and 8Ω.

4.2.5 Unknown Generator Check

1. Reconnect the resistance standard terminals 1 and 2 to the Model 262 STANDARD terminals 1 and 2. Connect the second resistance standard to the Model 262 unknown terminals. Set both standards to 100 Ω.

2. Set the Model 262 controls as follows:

   DEVIATION to PERCENT
   Range to 1%
   DEV RANGE to x1
   R_X V SELECT to 1 V

3. Connect the DVM low lead to the GRD terminal and the high lead to unknown terminal 4.

4. Hold down the PUSH TO ZERO button and turn the ZERO knob from one end of its range to the other. The MODEL 262 meter should move from +0.5 to -0.8; if it is out of range, adjust trimmer A (R24).

5. Zero the Model 262 meter with the ZERO knob, then release the PUSH TO ZERO button. The DVM should read -1 V ±0.025 V.

6. Set the R_X V SELECT switch to 5 V. The DVM should read -5 V ±0.05 V.

7. Set the R_X V SELECT switch to 1 V, DEVIATION switch to OHMS and each resistance standard to 10 Ω.

8. Change the "unknown" standard to 135 Ω ±10 Ω. The BRIDGE UNCAL lamp should light.

4.2.6 Functional Test and Final Alignment

1. Set the Model 262 controls as follows:

   DEVIATION to PERCENT
   Range to 10%
   DEV RANGE to x1
   R_X V SELECT to 1 V

   Set each resistance standard to 10 kΩ.

2. Connect the DVM low lead to a GRD terminal and the high lead to the rear panel OUTPUT terminal.

3. Adjust trimmer A (R24) for a DVM reading of 0 V ±1 mV.

4. Push the 0.1% range button and adjust the ZERO knob for a DVM reading of 0 V ±1 mV.

5. Push the 10% range button and check for a DVM reading of 0 V ±20 mV. If the reading is out of tolerance, repeat the above steps. This is the final detector zero adjustment.

6. Set the "unknown" standard to 9 kΩ and adjust the METER trimmer (R34) for full-scale deflection on the Model 262 meter.

7. Adjust trimmer R7 on the power supply board until the DVM reads -1.000 V ±1 mV. This is the final -15 V adjustment.

8. Set the R_X V SELECT switch to 5 V and the "unknown" standard to 10 kΩ.

9. Without pushing the PUSH TO ZERO button, adjust the ZERO knob for a DVM reading of 0 V ±1 mV.

10. Set the "unknown" standard to 9 kΩ. The DVM should read -1 V ±0.005 V.

11. Set the R_X V SELECT switch to 1 V and press the 1% range button.

12. Set the "unknown" standard to 10 kΩ and zero the Model 262 as in step 9.

13. Increase the unknown resistance in 0.1% steps and check the linearity on the Model 262 meter and DVM ±(0.5 ±2 mV).

14. Repeat step 12, then decrease the unknown resistance and check the linearity as in step 13.

15. Set R_X V SELECT switch to 5 V and repeat steps 12 and 13.

16. Set the R_X V SELECT switch to 1 V, the DEV RANGE switch to x3, and increase the unknown resistance in 1% steps. Check linearity as in steps 12 and 13.

17. Set the RANGE switch to x1, push the 0.1% button, set the "unknown" to 10 kΩ, and zero the Model 262 as in step 9.

18. Set the "unknown" to 10.01 kΩ. The DVM should read +1 V ±0.007 V, and the Model 262 meter should deflect full scale.

19. Set the "unknown" to 10.03 kΩ. The DVM should read about 3.00 V.

20. Set the DEV RANGE switch to x3. The DVM reading should remain at about 3.00 V.

SECTION 5

PARTS LIST AND SCHEMATIC DIAGRAMS

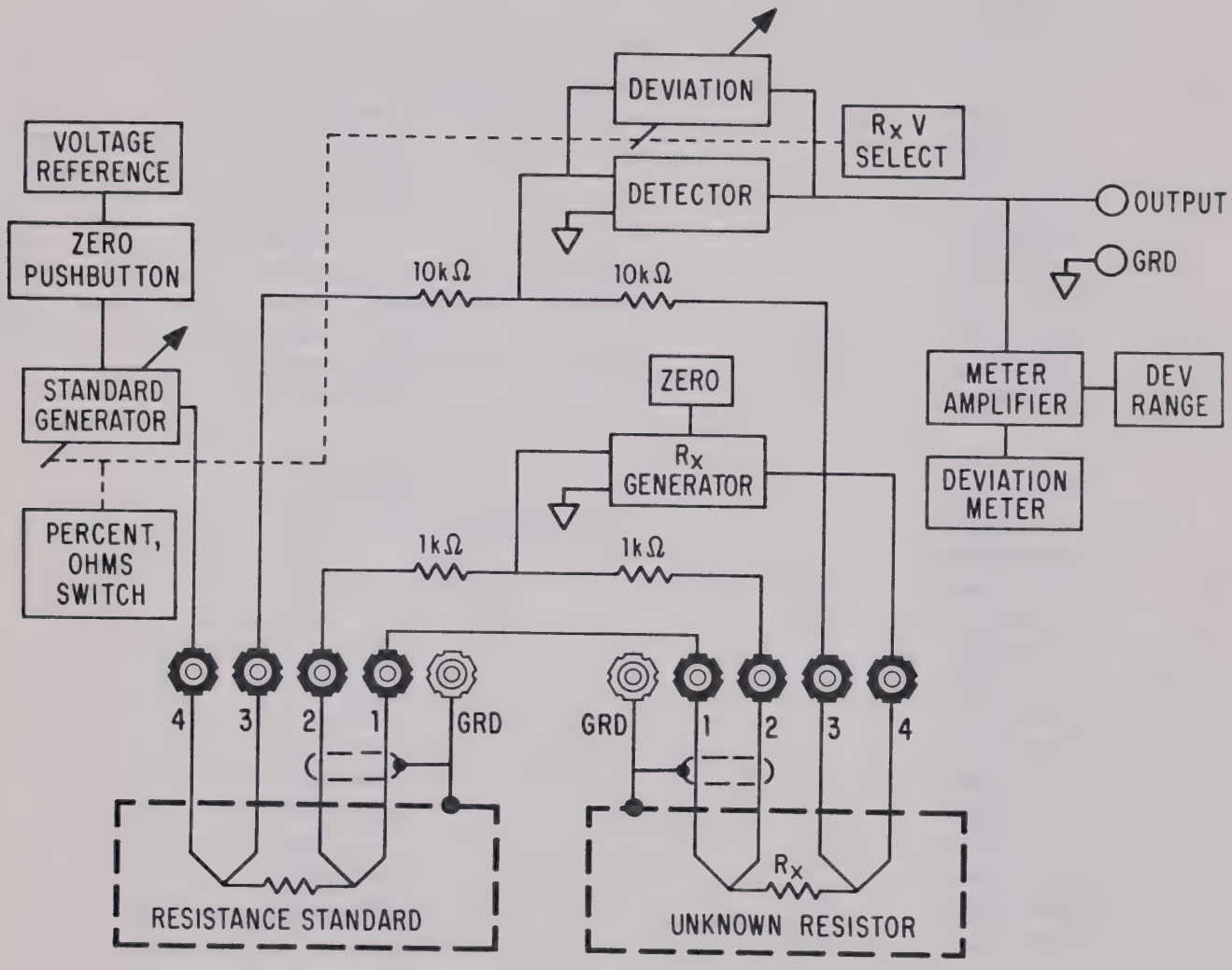


Figure 5-1. Model 262 Simplified Bridge Diagram

5.1 MAINFRAME

CIRCUIT NO.	DESCRIPTION	ESI PART NO.
A1	Circuit Board Assembly, Deviation Bridge	505-22849 See Section 5.2
A2	Circuit Board Assembly, ±15 V Power Supply	505-22847 See Section 5.3
C1	Capacitor, 0.01 μF 500 V 5%	313-18820
C2,C3	Capacitor, 0.01 μF 1 kV	313-01918
C4	Capacitor, 0.033 μF 100 V	313-20878
DS1	Lamp, Red	335-13696
DS2	Lamp, Green	335-13699
F1	Fuse, 1/2 A	333-01802
M1	Meter	337-13004A
R1	Potentiometer, 10 kΩ 10 Turn	306-22586
S1	Switch, Pushbutton	330-13595
S2-S4	Switch, DPDT	330-19093
S5	Switch, Pushbutton 4 Station	336-22853
T1	Transformer	340-20135
	Binding Post	112-01475
	Cap, Binding Post	112-01476
	Cap, Binding Post, Gold	112-01172
	Clip	710-13694
	Connector, 30 Pin	504-12243
	Foot	436-08739
	Fuse Holder	334-03074
	Knob	110-01472
	Lamp Socket	336-13689
	Line Cord	520-02520
	Medallion, ESI	130-01946
	PCB Holder	504-20142
	Sleeve	420-05014
	Strain Relief	506-03134
	Switch Cap	330-19094
	Terminal Strip	503-01755

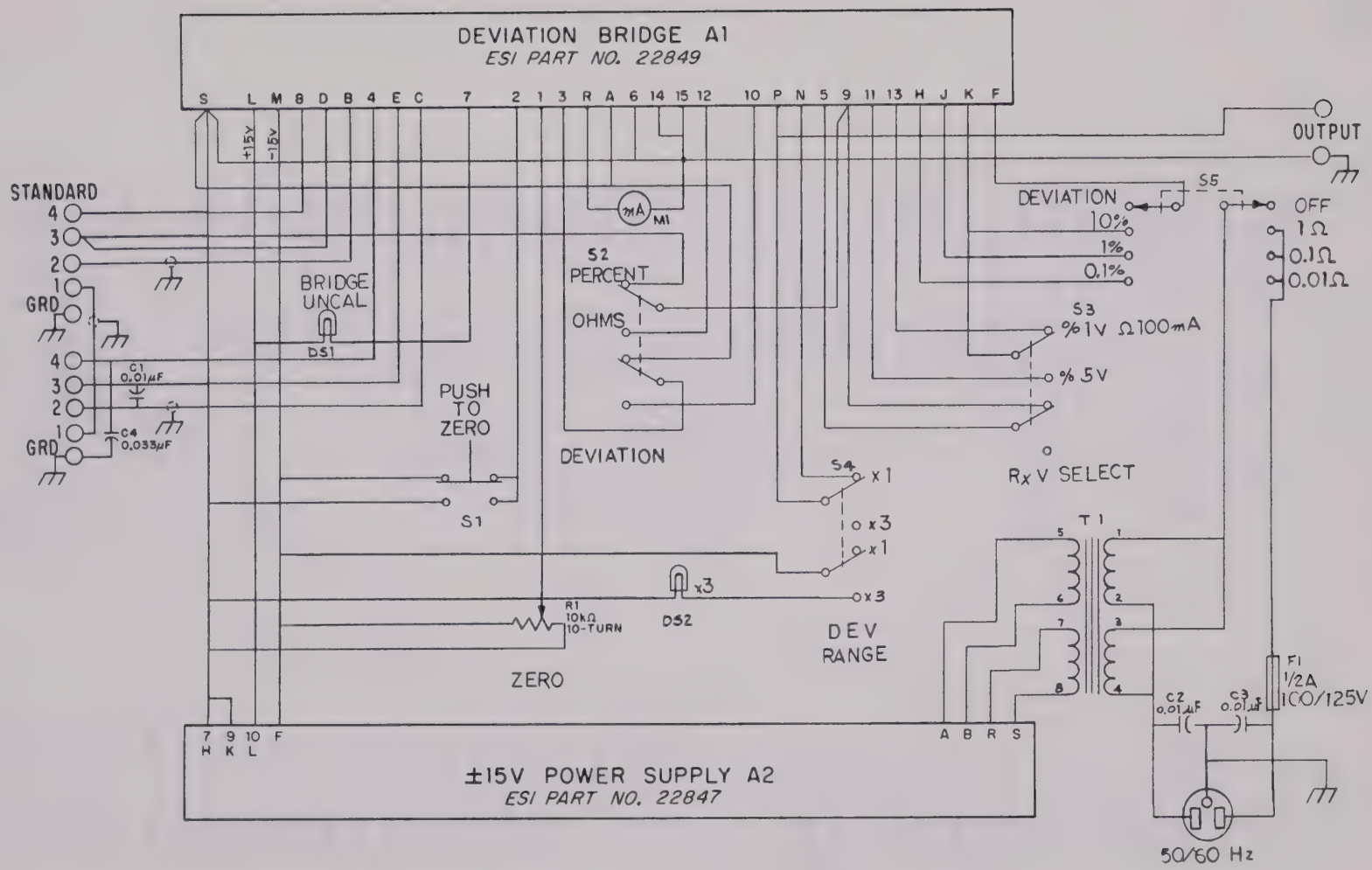


Figure 5-2. Model 262 Mainframe Schematic Diagram

5.2 DEVIATION BRIDGE CIRCUIT BOARD ASSEMBLY A1

CIRCUIT NO.	DESCRIPTION	ESI PART NO.
A1	Complete Assembly	505-22849
C1,C2	Capacitor, 0.05 μF, 100 V	311-12116
C3	Capacitor, 0.001 μF, 600 V	313-08094
C4	Capacitor, 0.005 μF, 500 V	313-18844
C5,C6	Capacitor, 2.2 μF, 20 V, 10%	314-13283
CR2	Diode, Zener, 1N4738A	321-12160
CR3-CR5	Diode, 1N914A	321-12356
Q1	Transistor, 2N3904	321-18751
Q2	Transistor, 2N4921 (MJE521)	321-18752
Q3	Transistor, 2N4918 (MJE371)	321-18753
Q4,Q5	Transistor, 2N2925	321-06467
R1	Resistor, 4 kΩ	240-22879
R2, R10, R13	Resistor, 1 kΩ	240-22863
R3,R6	Resistor, 15 kΩ	240-22867
R4	Trimpot, 10 kΩ	306-20145
R5	Resistor, 990 Ω	240-22862
R7	Resistor, 10 Ω	240-22873
R8	Resistor, 47 Ω, 2W, 10%	304-12173
R9,R18,R36	Resistor, 470 Ω, 1/4 W, 10%	307-13915
R11	Resistor, 4.7 kΩ, 1/4 W, 10%	307-13927
R12,R26	Resistor, 10 Ω, 1/4 W, 10%	307-13895
R14,R40	Resistor, 47 kΩ, 1/4 W, 10%	307-13941
R15	Resistor, 15 kΩ, 1/4 W, 10%	307-13935
R16	Resistor, 90 kΩ	240-22874
R17	Resistor, 990 kΩ, 1/2 W, 1%	305-02001
R19	Resistor, 1.8 Ω, 1/2 W, 10%	304-20136
R20,R21	Resistor, 10 kΩ	240-22866
R23	Resistor, 20 kΩ, 1/4 W, 1%	305-21743
R24	Trimpot, 50 kΩ	306-12091
R25	Resistor, 15 kΩ, 1/4 W, 1%	305-21198
R27	Resistor, 100 kΩ	240-22868
R28	Resistor, 11.111 kΩ	240-22871
R29,R30	Resistor, 20 kΩ	240-22869
R31	Resistor, 4 kΩ	240-22865
R32	Resistor, 2 kΩ	240-22864
R33	Resistor, 9.09 kΩ, 1/4 W, 1%	305-22858
R34	Trimpot, 2 kΩ	306-12084
R35	Resistor, 8.45 kΩ, 1/4 W, 1%	305-83288
R37	Resistor, 2.2 kΩ, 1/4 W, 10%	307-13924
R38	Resistor, Selected 1%	
U1,U4	Operational Amplifier, 741	343-20668
U2	Operational Amplifier, ADO-27B	343-25289
U3	Operational Amplifier, 118A	343-22854
	Circuit Board, Deviation Bridge	505-22848
	Heat Sink	329-22859

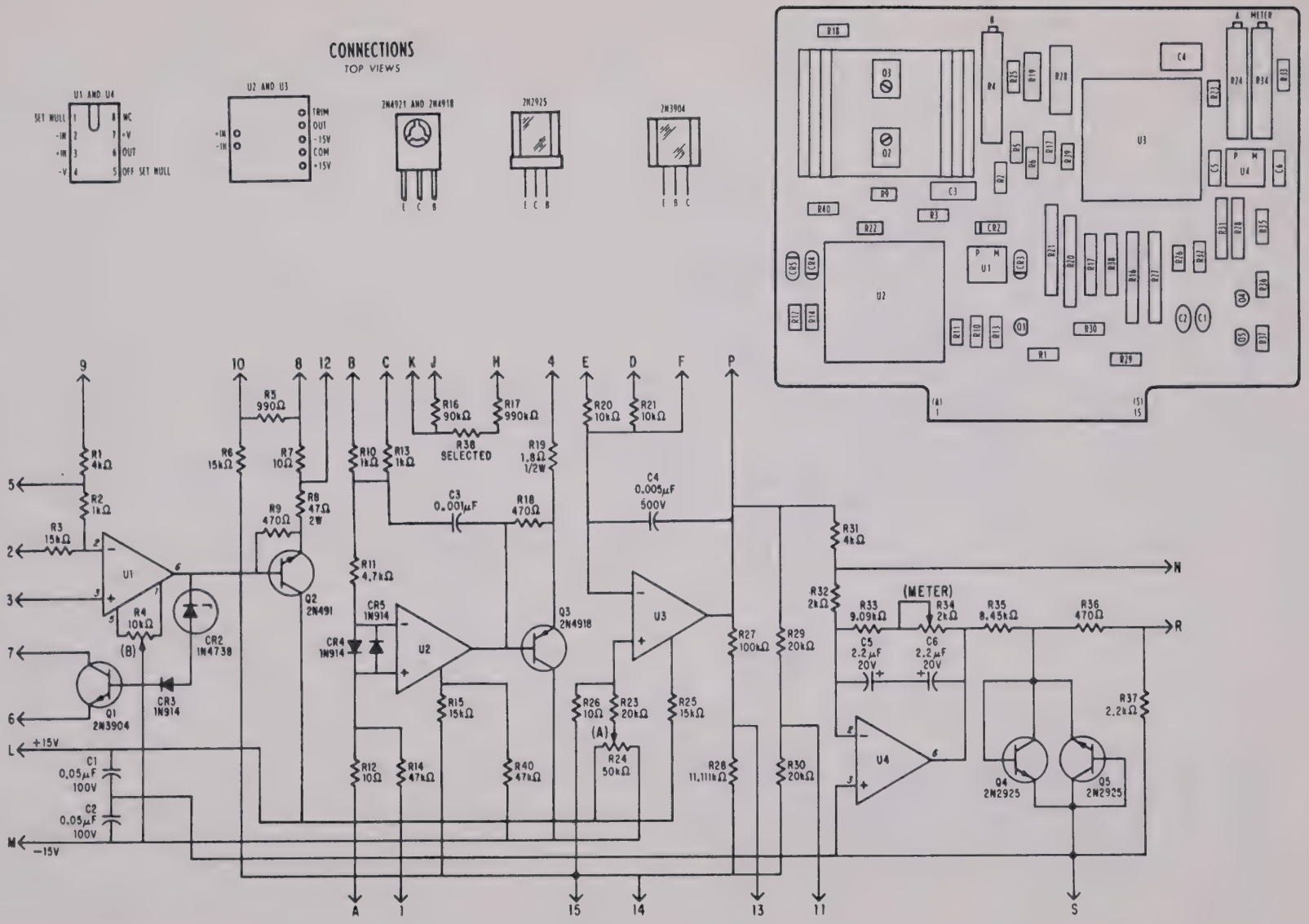


Figure 5-3. Model 262 Deviation Bridge Schematic Diagram

5.3 ±15 V POWER SUPPLY CIRCUIT BOARD ASSEMBLY A2

CIRCUIT NO.	DESCRIPTION	ESI PART NO.
A2	Complete Assembly	505-22847
C1,C2	Capacitor, 500 μF, 50 V	314-01942
C3,C4	Capacitor, 0.001 μF, 500 V	313-07094
C5,C6	Capacitor, 1 μF, 35 V	314-06472
CR1-CR8	Diode, 1N4005	321-01779
Q1,Q2	Transistor, 2N4921	321-18752
R1	Resistor, 1.5 Ω, 1/2 W, 10%	304-21454
R2	Resistor, 2.7 Ω, 1/2 W, 10%	304-06179
R3,R8	Resistor, 6040 Ω, 1/4 W, 1%	305-22856
R4,R7	Resistor, Variable, 2 kΩ	306-12084
R5,R6	Resistor, 6980 Ω, 1/4 W, 1%	305-22857
U11,U12	Integrated Circuit, Voltage Reg.	343-19752
	Etched Circuit Board, ±15 V Power Supply	505-22846
	Heat Sink	329-18771
	Test Jack, White	504-12149
	Test Jack, Black	504-12152
	Test Jack, Red	504-12153

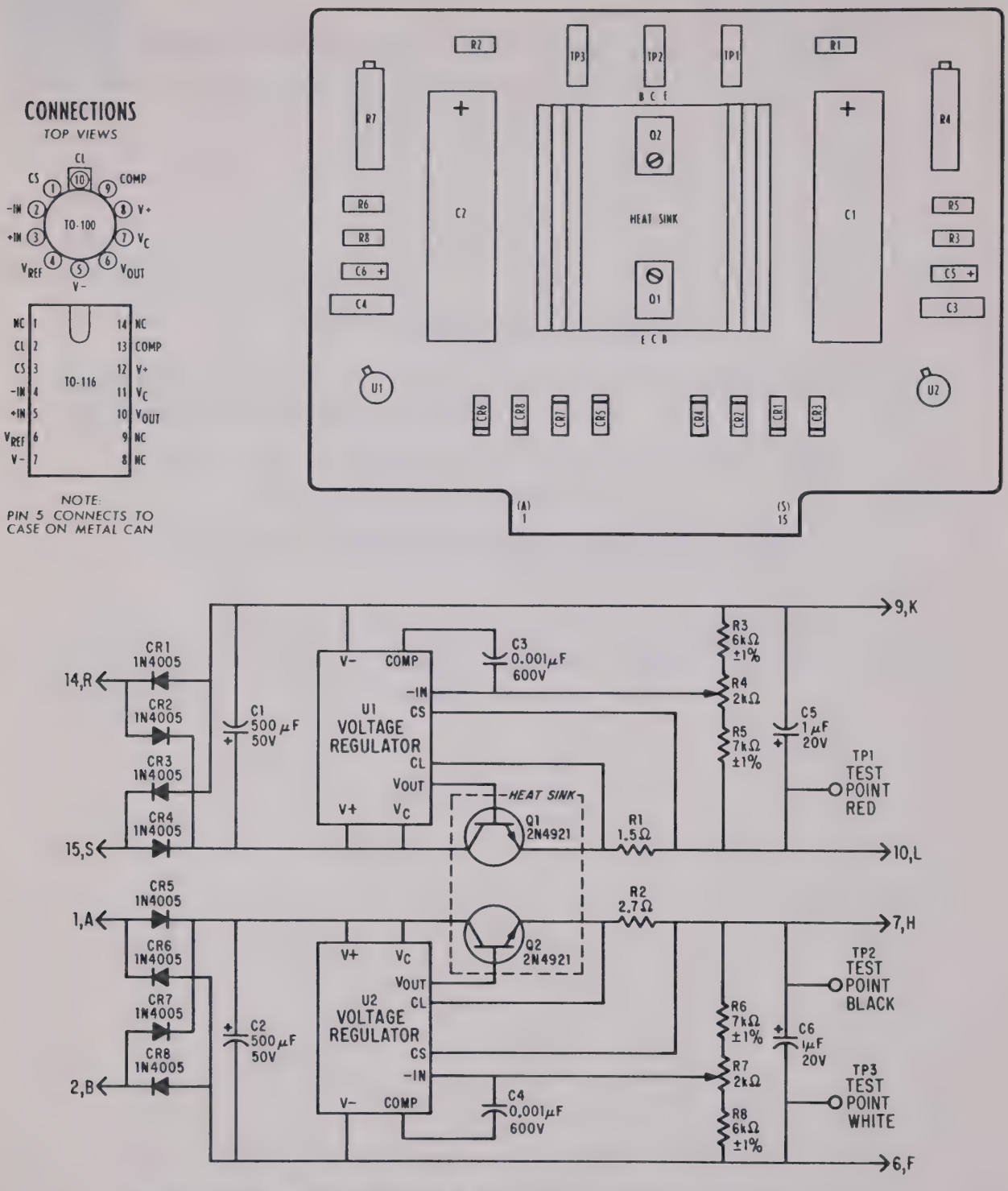


Figure 5-4. Model 262 ±15 V Power Supply Schematic Diagram

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1. Two years for components and instruments using passive circuitry. One year for repairs of out-of-warranty items.
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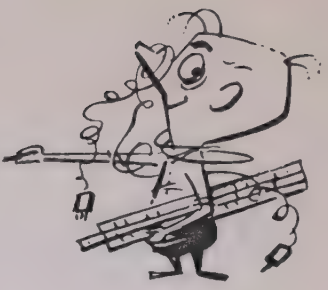

ESI technical publications are listed on the back of this page. If you would like any of these, simply check the appropriate box and fill in your address below. Also, please add any comments you have concerning the instrument or instruction manual. We value your feedback to help us improve or correct our manuals.

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☐ EB10 Effects of Output Loading on Resistive Voltage Dividers, *October 1969*

☐ EB15 Low Input Resistance Voltage Dividers, *February 1970*

☐ EB17 Accuracy vs. Frequency of Models 290B and 250DE Universal Impedance Bridges, *(revised May 1969)*

☐ EB26 International System of Units, *August 1969*

☐ EB29 DC and Low Frequency AC Ratio Measurements, *Dr. Merle L. Morgan, September 1962*

☐ EB30 Traceability of Resistance Measurement, *Jack Riley, January 1964*

☐ EB34 Resistance Transfer Technique, *Lawrence H. White, (revised April 1968)*

☐ EB35 An Improved Technique for Establishing Resistance Ratios, *R. M. Pailthorp and J. C. Riley, November 1962*

☐ EB41 Derivation of Electrical Units from Fundamental Standards, *R. D. Kuykendall and R. M. Pailthorp, July 1964*

☐ EB44 DC Measurements Using Ratio Techniques, *Jack C. Riley, September 1965*

☐ TA2 A Ratio Transformer Bridge for Standardization of Inductors and Capacitors, *D. L. Hillhouse and H. W. Kline, August 1960*

☐ TA6 The Accuracy of Series and Parallel Connections of Four-Terminal Resistors, *Jack C. Riley, April 1965*

☐ TA8 AC Measurements Using Ratio Techniques, *Jack C. Riley, May 1965*

☐ TA9 Strength for the Weak Spot in DC Potentiometry, *George D. Vincent and M. L. Roberts, October 1965*

☐ TA14 The Advantages of a Ten Kilohm Transportable Resistance Standard, *Robert M. Pailthorp, September 1967*

☐ TA16 Which Bridge for Precise Resistance Measurements? *Edward J. Swenson and George D. Vincent, December 1967*

☐ TA17 Experimental Verification of the Five-Terminal, Ten-Kilohm Resistor as a Device for Dissemination of the Ohm, *R. M. Pailthorp and George Vincent, December 1968*

☐ TA22A Laser Resistance Trimming from the Measurement Point of View, *Arthur G. Albin and Edward J. Swenson, June 1971*

☐ TA23 Precision Measurement of Resistor Networks, *Robert M. Pailthorp and Jack C. Riley, June 1971*

☐ TA24 Predictive Adjustment of Tantalum Film Resistors by Anodization, *Donald R. Cutler and Edward J. Swenson, July 1971*

☐ TA25 Laser Trimming Analysis Using a Resistive Sheet Analogy, *Swenson, Vincent, Riley, December 1972*

☐ TA26 The Effects of Laser Trimming on Birox and 1100 Series Thick Film Composition, *N. S. Spann, R. Headley, G. D. Vincent and E. J. Swenson, October 1971*

☐ TA27 Laser Trimming Thin Film Precision Resistor Networks with an Automated System, *Leonhard Groth, January 1974*

☐ TA28 YAG Laser Trimming of Thick Film Resistors, *Headley, Popowich, Anders January 1974*

☐ TA29 An Overview of Laser Functional Trimming Techniques, *Gunnar Hurtig III and Edward J. Swenson, August 1974*

☐ TA30 Measurement Subsystem for an AC Network Laser Trimmer, *R. A. Schomburg, August 1974*

☐ TA31 A Method of Obtaining Optimum Trimming Performance from a Laser System, *Paul F. Parks and Thomas W. Richardson, October 1974*

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